BIOASSESSMENT REPORT

RAPID BIOASSESSMENT OF THE

KOKOMO CREEK WATERSHED

USING BENTHIC MACROINVERTEBRATES

October 1999
May 2000

For the
Soil and Water Conservation District of
Howard County

Study Conducted By:

Greg R. Bright
Commonwealth Biomonitoring
8061 Windham Lake Drive
Indianapolis, Indiana 46214
(317) 297-7713

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EXECUTIVE SUMMARY

A rapid bioassessment technique was used to determine the degree of biological impairment present in Kokomo Creek in central Indiana prior to implementation of various land treatments in the watershed by the Howard County SWCD. The benthic communities of nine sites, including a reference site, were sampled during October 1999 and May 2000 to provide information on "before treatment" conditions. Three of the sites were sampled twice to provide information on how conditions changed between autumn and spring.

All of the study sites in the Kokomo Creek watershed had biotic index values less than the reference site. These sites showed "slight" to "severe" impacts. The differences were due to both degraded habitat and water quality. Water quality impacts were from inadequately treated sewage and excessive sediment inputs.

The most biologically impacted site was at CR 400 E, where only a few "sewage-tolerant" benthic organisms were present during the autumn of 1999. There was a corresponding sag in dissolved oxygen near this site. Downstream from CR 400 E, the benthic community of Kokomo Creek gradually improved. The biotic index scores did not change significantly between the autumn and spring sampling seasons at sites monitored more than once.

Recommendations to improve the condition of Kokomo Creek include working to improve wastewater treatment in the basin, bank stabilization using vegetative techniques, limiting access to the stream by livestock, restoring trees along streambanks, protecting the quality and quantity of spring water sources, and continued biological monitoring to gauge the success of the program. Although it is not a problem originating from agricultural uses of the watershed, the SWCD could also participate with IDEM in a study to locate important sources of PCB contamination in the watershed.

INTRODUCTION

This study was conducted to measure the "biological integrity" of Kokomo Creek in central Indiana. The stream is a tributary of Wildcat Creek in the Wabash River Basin. The stream is listed by the Indiana Department of Environmental Management (IDEM) as having seriously degraded water quality due to nonpoint sources of pollution such as excessive sediment and nutrient inputs from stormwater runoff [1].

To deal with this problem, the Howard County Soil and Water Conservation District sought and received a grant from the Indiana Department of Natural Resources to develop a soil conservation plan to help reduce nonpoint source problems in the stream. Prior to implementing the plan, the SWCD office decided to conduct a benthic study of the stream to document "before treatment" conditions.

Local Setting

Kokomo Creek is located in the "Central Corn Belt Plain" ecoregion of the Central U.S. [2]. The land in the watershed was molded by glacier activity and is relatively flat. The original forests were dominated by beech, maple, oak, and hickory trees but row crop agriculture and livestock grazing are the most common land uses today. In fact, about 95% of the watershed upstream from the City of Kokomo is devoted to agricultural uses. Only about 5% remains forested [19]. The lower portions of Kokomo Creek flow through a highly urbanized area prior to its confluence with Wildcat Creek.

IDEM has recently collected samples from Kokomo Creek for analysis of contaminants in fish tissue. Their results show high levels of PCBs in all fish species. Because of this, the State of Indiana has issued a "Group 5" consumption advisory for Kokomo Creek, discouraging people from eating any fish from the stream [7]. The source of PCB contamination is unknown but a Superfund Site (the old Continental Steel plant at the mouth of the creek in Kokomo) is a prime suspect because of high PCB levels present in various soil and water samples around the property.

A comprehensive water quality survey of Wildcat Creek was carried out by IDEM in 1994 [7]. High levels of E.coli bacteria were observed (3500 CFU per 100 ml) and dissolved oxygen fell below the minimum stream standard of 4 mg/l at several locations in the upper and middle sections of the watershed. The lower watershed within the City of Kokomo had sediments contaminated with various organic compounds, especially PAHs. Based on this information, IDEM classified Kokomo Creek as not supporting its designated uses for swimming and fishing.

Several facilities discharge sanitary wastewater to Kokomo Creek. These include Regency Mobile Home Park, Taylor High School, and Timbernest Apartments. Three of the four dischargers exceeded suspended solids permit limits in surveys conducted in 1993 and 1994 [7]. Ammonia levels in the effluent were also relatively high (3-7 mg/l) during the surveys conducted by the Indiana Department of Environmental Management. Within the City of Kokomo, Delco Electronics and Chrysler have NPDES permits to discharge cooling water to Kokomo Creek. A map showing the locations of these wastewater dischargers is shown below.

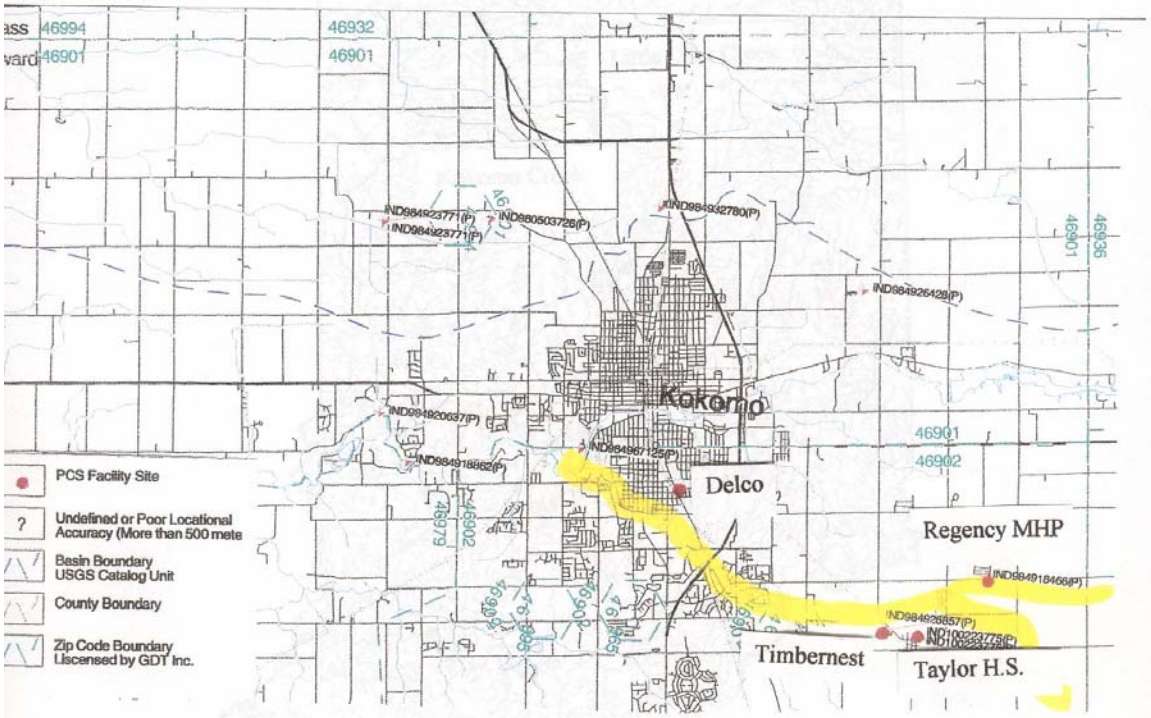
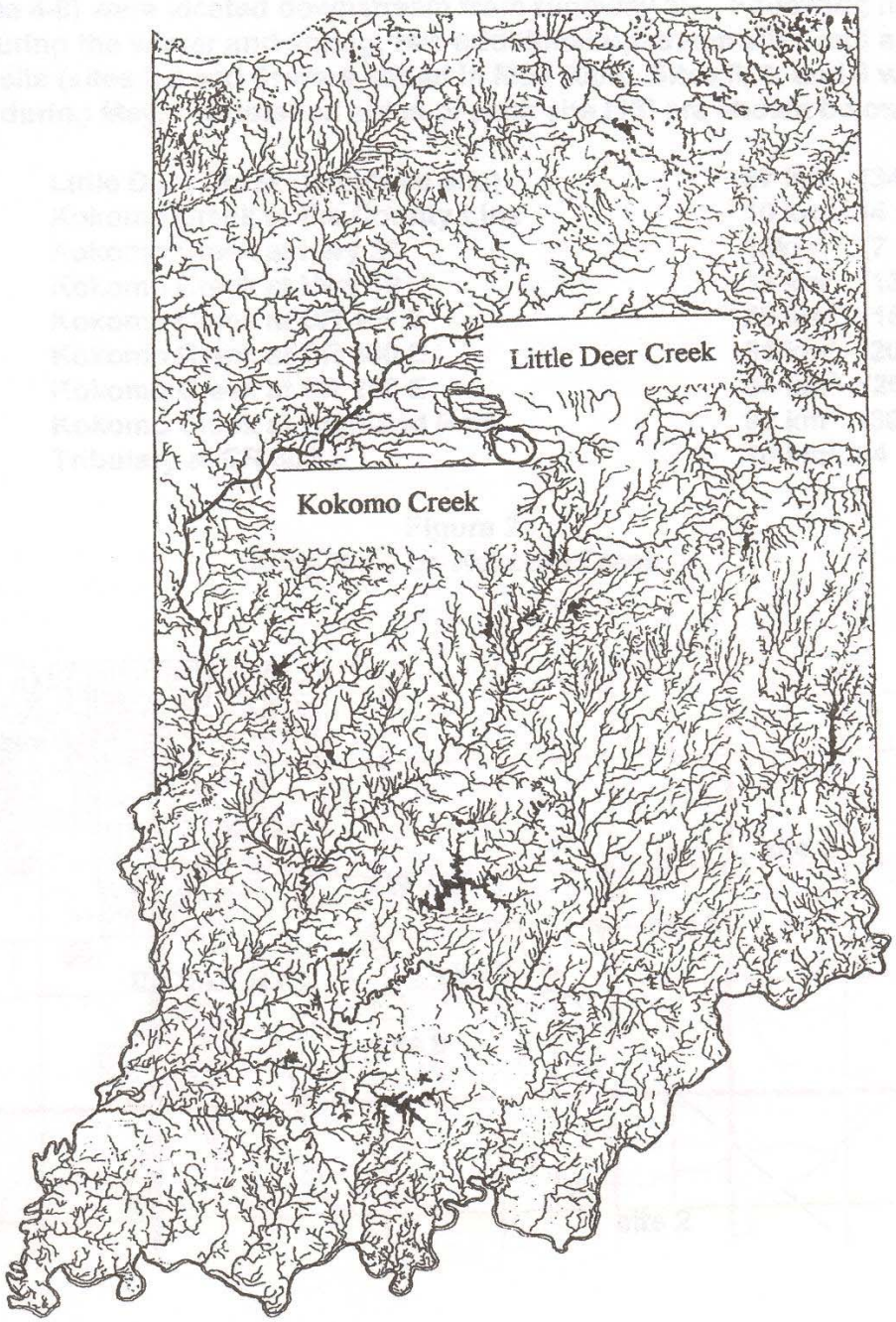


Figure 1.

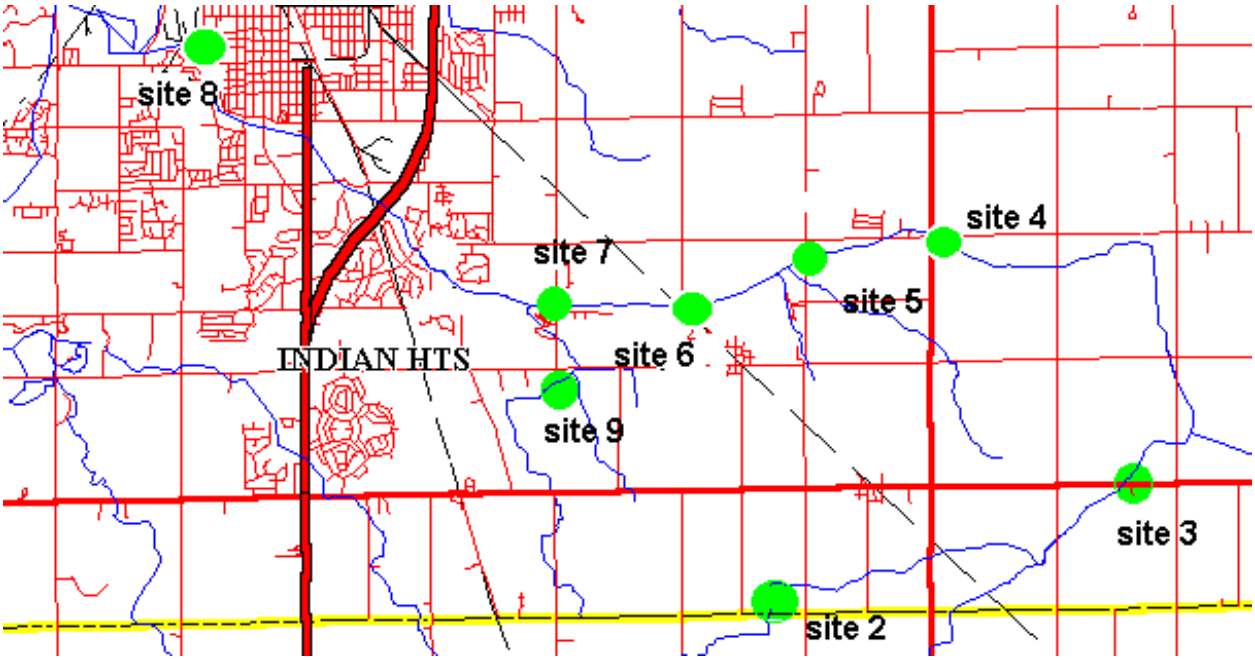
Kokomo Creek and Little Deer Creek Watersheds



A total of nine sites were sampled during this study. Because of a prolonged drought during the late summer of 1999, areas of Kokomo Creek upstream from Highway 19 were reduced to isolated pools which did not support a representative benthic community. Therefore, all sites sampled during October 1999 (sites 4-8) were located downstream from Highway 19. Following normal rainfall during the winter and spring, two additional upstream sites and a tributary site (sites 2,3 and 9) were added in May 2000. Sites 5, 6, and 8 were not sampled during May. Watershed areas of each site [18] are shown below:

Site 1	**Little Deer Creek (reference site)**	**87 km^2 (34 mi^2)**
Site 2	**Kokomo Creek at the County Line**	**10 km^2 (4 mi^2)**
Site 3	**Kokomo Creek at Hwy 26**	**18km^2 (7 mi^2)**
Site 4	**Kokomo Creek at Hwy 19**	**33 km^2 (13 mi^2)**
Site 5	**Kokomo Creek at CR 400 E**	**38 km^2 (15 mi^2)**
Site 6	**Kokomo Creek at CR 300 E**	**51 km^2 (20 mi^2)**
Site 7	**Kokomo Creek at CR 200 E**	**64 km^2 (25 mi^2)**
Site 8	**Kokomo Creek at Highland Park**	**92 km^2 (36 mi^2)**
Site 9	**Tributary at CR 300 S**	**10 km^2 (4 mi^2)**

Figure 2
Study Sites on Kokomo Creek



METHODS

Because they are considered to be more sensitive to local conditions and respond relatively rapidly to environmental change [3], benthic (bottom-dwelling) organisms were used to document the biological condition of each stream. The U.S. Environmental Protection Agency (EPA) has recently developed a "rapid bioassessment" protocol [4] which has been shown to produce highly reproducible results that accurately reflect changes in water quality. We used EPA's Protocol III to conduct this study. Protocol III requires a standardized collection technique, a standardized subsampling technique, and identification of at least 100 animals from each site to the genus or species level from both "study sites" and a "reference site." CPOM (Coarse Particulate Organic Matter) samples were collected and analyzed to determine the percentage of shredder organisms.

Reference Site

The aquatic community of a reference site is compared to that of each study site to determine how much impact has occurred. The reference site should be in the same "ecoregion" as the study sites and be approximately the same size. It should be as pristine as possible, representing the best conditions possible for that area.

A recent study [5] found that Little Deer Creek had one of the best fish communities and habitat values in the area. Little Deer Creek has a drainage area which is similar to the study sites and lies only a few miles to the west, in the same ecoregion. Therefore, this site (Site 1) was used as the basis of comparison for all other sites in the study.

Habitat Analysis

Habitat analysis was conducted according to Ohio EPA methods [21]. In this technique, various characteristics of a stream and its watershed are assigned numeric values. All assigned values are added together to obtain a "Qualitative Habitat Evaluation Index." The highest value possible with this habitat assessment technique is 100.

Water Chemistry

Water chemistry measurements were made at each study site on the same day that macroinvertebrate samples were collected. Dissolved oxygen was measured by the membrane electrode method. The pH measurements were made with a Cole-Parmer pH probe. Conductivity was measured with a Hanna Instruments meter. Temperature was measured with a mercury thermometer. All instruments were calibrated in the field prior to measurements.

Macroinvertebrate Sample Collection

Samples in this study were collected by kicknet from riffle habitat where current speed was 20-30 cm/sec. Riffles were used because they typically support the most diverse benthic community in streams. The kicknet was placed immediately downstream from the riffle while the sampler used a hand to dislodge all attached benthic organisms from rocks upstream from the net. The organisms were swept by the current into the kicknet and subsequently transferred to a white pan. Each sample was examined in the field to assure that at least 100 organisms were collected at each site. In addition, each site was sampled for organisms in CPOM (coarse particulate organic matter, usually consisting of leaf packs from fast-current areas). All samples were preserved in the field with 70% ethanol.

Laboratory Analysis

In the laboratory, a 100 organism subsample was prepared from each site by evenly distributing the whole sample in a white, gridded pan. Grids were randomly selected and all organisms within grids were removed until 100 organisms had been selected from the entire sample.

Each animal was identified to the lowest practical taxon (usually genus or species). As each new taxon was identified. a representative specimen was preserved as a "voucher." All voucher specimens have been deposited in the Purdue University Department of Entomology collection.

RESULTS

Aquatic Habitat Analysis

When the Ohio EPA habitat scoring technique was used, the following aquatic habitat values were obtained for each site in the study:

	Score	% of Reference
Little Deer Creek (Site 1)	72	100
Kokomo Creek - County Line (Site 2)	41	57
Kokomo Creek - Hwy 26 (Site 3)	58	81
Kokomo Creek - Hwy 19 (Site 4)	46	64
Kokomo Creek - CR 400 E (Site 5)	52	72
Kokomo Creek - CR 300 E (Site 6)	60	83
Kokomo Creek - CR 200 E (Site 7)	62	86
Kokomo Creek - Highland Park (Site 8)	62	86
Tributary at CR 300 S (Site 9)	49	68

The maximum value obtainable by this scoring technique is 100, with higher values indicating better habitat. Sites with lower habitat values normally have lower biotic index values as well. Details of the habitat scores for each site are shown in the appendix.

The scores indicate that the lowest habitat value in this study was at Site 2 (Kokomo Creek at the County Line). Habitat at Site 2 was hampered by a paucity of stable bottom substrate and instream cover, by the lack of any riparian buffer zone, by intermittent flow, and by moderately heavy bank erosion.

Water Quality Measurements
October 22, 1999

	D.O. mg/l	pH SU	Cond. uS	Temp. (C)
Site 1 (Little Deer Creek) Time = 4:30 p.m.	10.4	8.2	500	14.5
Site 4 (Hwy. 19) Time = noon	8.7	7.6	600	11.0
Site 5 (CR 400 E) Time = 2:15 p.m.	9.3	7.6	700	12.0
Site 6 (CR 300 E) Time = 1:30 p.m.	5.9	7.9	600	12.0
Site 7 (CR 200 E) Time = 10:15 a.m.	6.1	7.6	600	11.0
Site 8 (Highland Park) Time = 3:30 p.m.	7.6	7.5	600	13.5

Water Quality Measurements
May 23, 2000

	D.O. mg/l	pH SU	Cond. uS	Temp. (C)
Site 1 (Little Deer Creek) Time = 9:30 a.m.	8.3	7.8	500	18.0
Site 2 (County Line) Time = 11:15 a.m.	11.1	8.0	500	17.5
Site 3 (Hwy 26) Time = 10:25 a.m.	9.4	7.8	500	16.0
Site 4 (Hwy 19) Time = 11:50 a.m.	10.6	8.1	500	17.0
Site 7 (CR 200 E) Time = 1:15 p.m.	7.4	7.8	600	16.5
Site 9 (tributary @ CR 300 S) Time = 2:15 p.m.	9.0	7.6	600	16.5

D.O. = Dissolved Oxygen
Cond. = Conductivity
Temp. = Temperature in Degrees Centigrade

Mussel Observations

Live mussels were observed in both streams. In Kokomo Creek, live mussels occurred only upstream from Highway 19 (site 4). They included:

Lampsilis siliquoidea
Anodontoides ferussacianus

Live mussels in Little Deer Creek at site 1 included:

Lampsilis siliquoidea
Anodontoides ferussacianus
Fusconaia flava
Toxolasma parvus

Quality Assurance Duplicate Results

Sample Site - Kokomo Creek at CR 200 E
Sample Date - October 22, 1999
Samplers - Greg R. Bright (sample 1), Jennifer Bratthauar (sample 2)

	Sample 1		Sample 2	
	Data	Score	Data	Score
Total Genera	11	2	12	4
EPT Genera	2	0	2	0
Scrapers/Filterers	3.4	6	0.5	6
% Dominant Taxon	44	0	33	2
EPT/Chironomids	0.5	2	0.8	4
Community Loss Index	1.1	4	1.0	4
Hilsenhoff Biotic Index	6.2	4	6.8	4
% Shredders	4	6	0	0
TOTAL SITE SCORE		24		24

Each duplicate was identical, indicating "slight impairment." This indicates that the bioassessment technique provided reproducible results.

Table 1.
Rapid Bioassessment Results - Kokomo Creek
October 1999

	Site #					
	1	4	5	6	7	8
Chironomidae (Midges)						
Cricotopus bicinctus	6					4
Orthocladius obumbratus	14					
Eukiefferiella discoloripes	4					1
Nanocladius spp.	2					
Tanytarsus sp.	2					
Glyptotendipes lobiferus	4					
Chironomus decorus	1	29	34		2	2
Dicrotendipes nervosus	2		8	5	2	
Tribelos spp.				5		
Polypedilum convictum	2				6	
Procladius spp.				5		
Thienemannymia gr.	2				4	10
Ablabesmyia sp.					22	22
Simuliidae (Blackflies)	1					
Syrphidae (Rattail maggots)						
Eristalis				5		
Tipulidae (Craneflies)						
Tipula sp.				5	4	1
Ephemeroptera (Mayflies)						
Stenonema vicarium	1					
Stenacron interpunctatum					1	
Trichoptera (Caddisflies)						
Cheumatopsyche spp.	49	7			13	37
Hydropsyche betteni	1					
Ceratopsyche bifida	4					
C. slossonae	3					
Plecoptera (Stoneflies)						
Allocapnia sp.	1					
Odonata (Dragonflies)						
Basiaeschna sp.					1	
Argia spp.		14				4
Ischnura spp.		7				
Megaloptera (Alderflies)						
Sialis sp.					1	
Coleoptera (Beetles)						
Stenelmis crenata		7				
Stenelmis larvae				30	44	13
Dubiraphia larvae			6			

Table 1 (continued)
Rapid Bioassessment Results - Kokomo Creek
October 1999

	Site #					
	1	4	5	6	7	8
Isopoda (Pillbugs)						
Caecidotea spp.				20		
Amphipoda						
Hyalella azteca		29				
Gastropoda (Snails)						
Ferrissia spp.				5		1
Physella gyrina	1		46	15		1
Gyraulus spp.						
Pelecypoda (Clams)						
Corbicula fluminea		7		5		
Turbellaria (Flatworms)						1
Oligochaeta (Worms)						
Tubificidae			6			3
Total	100	100	100	100	100	100

Table 2. Data Analysis for 10/99 Samples

METRICS

	Site # 1	4	5	6	7	8
# of Genera	17	7	5	10	11	13
Biotic Index	6.4	8.2	9.3	7.7	6.2	6.9
Scrapers/Filterers	0.2	0.5	46	10	3.4	0.5
EPT/Chironomids	1.5	0.2	0.0	0.0	0.5	1.0
% Dominant Taxon	28	29	46	30	44	37
EPT Index	5	1	0	0	2	1
Community Loss Index	0.0	2.1	2.8	1.5	1.1	0.8
% Shredders	4	0	0	5	4	1

10/99 SCORING

	Site # 1	4	5	6	7	8

# of Genera	6	2	0	2	2	4
Biotic Index	4	2	0	2	4	4
Scrapers/Filterers	6	6	6	6	6	6
EPT/Chironomids	6	0	0	0	2	4
% Dominant Taxon	4	4	0	2	0	2
EPT Index	6	0	0	0	0	0
Community Loss Index	6	2	2	4	4	4
% Shredders	6	0	0	6	6	2
TOTAL	44	16	8	22	24	26
% of Reference	100	36	18	50	55	59
Impairment Category	N	M	Sv	M	S	S

N = NONE S = SLIGHT M = MODERATE Sv = SEVERE

Table 3.
Rapid Bioassessment Results - Kokomo Creek
May 2000

	Site #					
	1	2	3	4	7	9

Chironomidae (Midges)						
Cricotopus bicinctus		2	2	31		
C. trifascia	2			39		
C. tremulus			8		2	
Orthocladius obumbratus	2		10			
Euorthocladius sp.	2					
Rheotanytarsus exiguous		1	39			16
Paratanytarsus spp.			6		4	52
Dicrotendipes nervosus				3		
Microtendipes caelum					32	
Polypedilum convictum	1					
Thienemannymia gr.	8		2		6	
Ablabesmyia sp.	6			4		
Simuliidae (Blackflies)	12	76	11		1	4
Ceratopogonidae (Biting midges)					1	
Tipulidae (Craneflies)						
Tipula sp.	1	1			1	2
Antocha sp.					1	
Ephemeroptera (Mayflies)						
Stenonema vicarium	1					
Stenacron interpunctatum					1	
Baetis intercalaris	5		1			
B. brunneicolor	1					
Isoynchia sayi	1					
Caenis elymene				3		
Trichoptera (Caddisflies)						
Cheumatopsyche spp.	21				2	
Odonata (Dragonflies)						
Anax sp.	1					
Coleoptera (Beetles)						
Stenelmis crenata	1		1		3	
Stenelmis larvae	21		2		31	
Dubiraphia larvae	1					
Macronychus glabratus			1			
Optioservus sp.	1		1			
Berosus sp.	1		3	3		2
Dytiscus sp.		2				

Table 3 (continued)
Rapid Bioassessment Results - Kokomo Creek
May 2000

	Site #					
	1	2	3	4	7	9
Isopoda (Pillbugs)						
Caecidotea spp.					1	
Amphipoda						
Hyalella azteca				1		
Decapoda (Crayfish)						
Orconectes sp.		2		1		
Gastropoda (Snails)						
Stagnicola sp.			1			
Physella gyrina		12	12	14		16
Gyraulus spp.						1
Elimia livescens						1
Pelecypoda (Clams)						
Corbicula fluminea				3	8	4
Sphaerium sp.						1
Turbellaria (Flatworms)	11					
Oligochaeta (Worms)						
Tubificidae		3		2		
Lumbricidae					2	1
Hirudinea (Leeches)		1				
Total	100	100	100	100	100	100

Table 4. Data Analysis for 5/00 Samples

METRICS	Site # 1	2	3	4	7	9
# of Genera	18	8	13	9	14	11
Biotic Index	6.1	6.6	7.0	8.0	6.1	6.8
Scrapers/Filterers	0.7	0.2	2.4	28	3.2	2.0
EPT/Chironomids	1.4	0	0	0	0.1	0
% Dominant Taxon	22	76	39	39	34	52
EPT Index	5	0	1	1	2	0
Community Loss Index	0.0	1.9	0.8	1.1	0.8	1.4
% Shredders	1	1	0	0	1	1

MAY 200 SCORING	Site # 1	2	3	4	7	9

# of Genera	6	2	4	2	4	4
Biotic Index	6	4	2	0	6	4
Scrapers/Filterers	6	2	6	6	6	6
EPT/Chironomids	6	0	0	0	0	0
% Dominant Taxon	4	0	2	2	2	0
EPT Index	6	0	0	0	0	0
Community Loss Index	6	2	4	4	4	4
% Shredders	6	6	0	0	6	6
TOTAL	46	16	18	14	28	24
% of Reference	100	35	39	30	61	52
Impairment Category	N	M	M	M	S	M

N = NONE S = SLIGHT M = MODERATE Sv = SEVERE

Summary of Aquatic Community Index Scores (Normalized to 100)

	Site Number								Watershed
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Average**
May	**35**	**39**	**30**			**61**		**52**	**43**
Oct.			**36**	**18**	**50**	**55**	**59**		**44**

DISCUSSION

Chemical parameters measured at each site indicate that dissolved oxygen (D.O.), pH, temperature, and conductivity fell within acceptable ranges for most forms of aquatic life. However, there was a distinct sag in dissolved oxygen

below CR 400 E during October 1999 and below Highway 19 during May 2000. This usually indicates that a source of oxygen-consuming wastewater is discharged nearby.

A total of 57 macroinvertebrate genera were collected at the nine sites. The most commonly collected invertebrates were midge larvae and riffle beetles. The pollution intolerant groups Ephemeroptera, Plecoptera, and Trichoptera (mayflies, stoneflies, and caddisflies) were abundant only at the reference site and at the site 8 (Highland Park) on Kokomo Creek. Mayflies were conspicuously rare or absent at all sites.

Tables 2 and 4 show how the aquatic communities of Kokomo Creek compared to that of the reference site. Impacted sites are shown graphically in Figure 3. Kokomo Creek's impairment ranged from "moderate" in the upper watershed to "severe" in the middle watershed to "slight" in the lower watershed.

Figure 4 shows the normal relationship of biotic index scores to habitat values (a linear relationship according to [4]). The figure also shows a range of plus or minus 10% to account for a certain amount of measurement variability. When biotic index values fall outside this range, the site typically has degraded water quality. Figure 4 indicates that none of the study sites had biotic values within the range expected from its measured habitat value. Therefore, the lower than expected biotic values are both water quality and habitat degradation.

The largest deviation from the expected value occurred at Site 5 (CR 400 E). This site was downstream from the wastewater treatment discharge of Kokomo Regency Mobile Home Park. Only a few sewage-tolerant animals (those with Hilsenhoff Biotic Index values greater than 8) were present at this site. The dissolved oxygen sag noted above was also located in this area. Below this site, the biotic index value began to climb back upward, indicating a gradual recovery from severely degraded water quality conditions. The sites monitored twice during this study (sites 4 and 7) showed no significant differences in biotic index values between autumn and spring sampling periods.

Figure 3.
Degrees of Biological Impairment in Kokomo Creek

Yellow = Slight Impairment
Orange = Moderate Impairment
Red = Severe Impairment

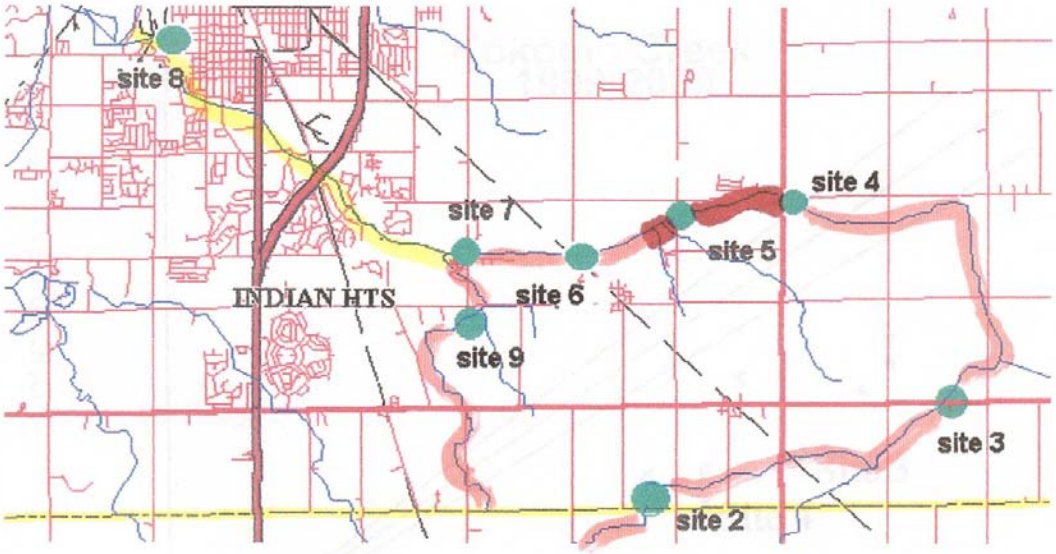


Figure 4.

The normal relationship between habitat and biotic index score is shown below. Sites falling outside the normal relationship (plus or minus 10%) are probably affected by degraded water quality.

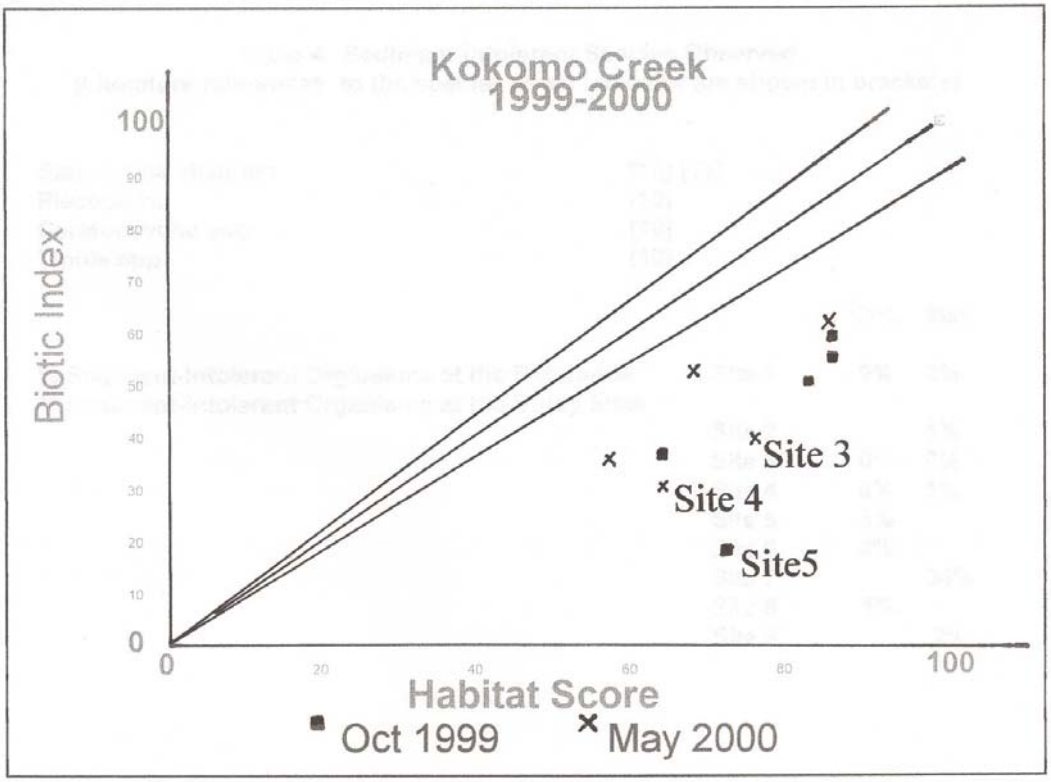


Table 4 shows sediment-tolerance values for many of the commonly collected animals in these streams. The proportion of sediment and turbidity-intolerant forms was lower at the reference site than at any of the study sites. These results indicate that sediment-related impairment may be contributing to the water quality problems in the Kokomo Creek watershed. This is especially true in the upper part of the watershed, where almost no sediment-intolerant forms of life were found.

Table 4. Sediment-Intolerant Species Observed
(Literature references to the species as an indicator are shown in brackets)

Stenonema vicarium	**[10] [15]**
Plecoptera	**[10]**
Ceratopsyche spp.	**[10]**
Tipula spp.	**[10]**

		Oct.	May
% Sediment-Intolerant Organisms at the Reference	**Site 1**	**9%**	**2%**
% Sediment-Intolerant Organisms at the Study Sites			
	Site 2		**1%**
	Site 3	**0%**	**0%**
	Site 4	**0%**	**1%**
	Site 5	**5%**	
	Site 6	**4%**	
	Site 7		**34%**
	Site 8	**1%**	
	Site 9		**2%**

Comparison to Previous Studies

There have been no previous studies of the macroinvertebrates of Kokomo Creek. A small amount of fisheries data exists in the files of the Indiana Department of Environmental Management (IDEM) as the agency collected fish tissue for contaminant analysis. However, the fish collections were not done using methods suitable for rapid bioassessment and are not further considered in this report.

The reference stream (Little Deer Creek) was studied by Simon & Dufour [5]. They found the following fish characteristics at a site they collected in 1994:

	Observed	IBI Score
Number of species	20	5
Number of darter species	3	5
Number of sunfish species	3	3
Number of sucker species	3	3
Number of sensitive species	9	5
Percent tolerant fish	6	5
Percent omnivorous fish	1	5
Percent insectivorous fish	76	5
Percent pioneer fish	27	3
Percent lithophilic fish	19	1
Number of fish caught per hour	140	3
Percent of fish with tumors or lesions	0	5

The total IBI score of this site was 48 out of 60, which ranks it in the "good" category of biotic integrity.

If it's full potential of biotic integrity is restored, Kokomo Creek could be expected to support a similar fish community.

RECOMMENDATIONS

1. **Notify the Indiana Department of Environmental Management of the need to improve the quality of water discharged from the wastewater treatment plants in the watershed.**

2. **Work toward continued protection of the vegetative buffer zone along the stream corridors. Tree plantings along streams should be encouraged.**

3. **Discourage channelization of the stream. Minimizing channelization allows the streams to retain a natural channel that enhances aquatic habitat.**

4. **Discourage direct access to the streams by livestock. Large numbers of livestock can trample stream banks, decreasing the ability of streamside vegetation to filter out pollutants and hastening erosion.**

5. **Consider a bank stabilization program on some of the headwater streams. Use vegetative stabilization techniques rather than rip-rap whenever possible.**

6. **Continue to monitoring Kokomo Creek every 3 to 5 years to determine whether conditions improve. Consider conducting a fish community study to supplement the benthos data.**

7. **Continue to encourage volunteer monitoring in the watershed. Such programs provide invaluable educational opportunities and give participants a sense of ownership in the water quality improvements observed over the years.**

8. **Although agricultural uses of the land do not normally contribute to PCB contamination, the Howard County SWCD could play a role in investigating sources of PCB's in Kokomo Creek. This could be coordinated with IDEM's Office of Water Management.**

9. **Protect spring-fed sources of flow in Kokomo Creek. The artesian spring along CR 130 E, south of Kokomo, provides clear, cool water to a tributary of Kokomo Creek.**

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Habitat Scoring Results

	Site Number								
	1	2	3	4	5	6	7	8	9
SUBSTRATE	12	6	10	6	7	10	10	10	10
COVER	9	3	10	5	6	8	8	8	5
CHANNEL	12	8	9	8	9	10	11	11	8
RIPARIAN	11	7	8	7	8	10	9	8	8
POOL/RIFFLE	12	5	8	6	8	7	9	9	6
GRADIENT	6	6	6	6	6	6	6	6	6
DRAINAGE AREA	10	6	7	8	8	9	9	10	6
TOTAL	72	41	58	46	52	60	62	62	49

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Identification	Waterbody and Segment names	Size in miles	303d List Year	Use				Cause/Stressor													
				Aquatic Life	Drinking Supply	Fish Consumption	Contact Recr	Biotic comm *	Copper	Cyanide	Lead	Mercury	Low DO	Pathogens	PCBs	Pesticides	Organics	TDS/chloride	Ammonia
	EIGHTMILE CREEK - UPPER MIDDLE																		
INB01B3_00	Eightmile Creek - upper middle	6.5		N		X	X	H											
	EIGHTMILE CREEK - WITZGALL DITCH																		
INB01B5_T1028	Witzgall Ditch - above Johnson Dt	3.54		F		X	X												
	GRASSY CREEK - BIG BARBEE/ SECHRIST LAKES																		
INB0617_T1036	Grassy Creek	5.38		P		X	X	S											
	GRASSY FORK DITCH - HARPER DITCH																		
INB0711_00	GRASSY FORK DITCH - HARPER DITCH	13.6		F		X	N							S					
	HOAGLAND DITCH - MINCH DITCH																		
INB06C7_00	HOAGLAND DITCH - MINCH DITCH	10.2		F		X	X												
	HONEY CREEK																		
INB01G8_00	Honey Creek	9.36		F		X	X												
	HONEY CREEK - SHAFER DAM																		
INB06CB_00	HONEY CREEK - SHAFER DAM	11.7		F		X	X												
	HUNTINGTON LAKE																		
INB0191_P1008	Huntington Lake	8.45		F		X	X												
	KILMORE CREEK - BOYLES DITCH																		
INB0749_00	KILMORE CREEK - BOYLES DITCH	14.4		F		X	N							S					
	KILMORE CREEK - SHANTY CREEK																		
INB0745_00	KILMORE CREEK - Shanty Creek	11.5		F		X	F												
	KILMORE CREEK - SR 29 TO KILMORE																		
INB0748_00	KILMORE CREEK - SR 29 TO KILMORE	7.18		F		X	F												
	KILMORE CREEK - STUMP DITCH																		
INB0747_00	KILMORE CREEK - STUMP DITCH	11.7		F		X	F												
	KOKOMO CREEK - HEADWATERS																		
INB071B_00	Finn Ditch and other tributaries	8.35		F		X	P							S					
INB071B_T1007	Kokomo Creek - mainstem headwaters	12	1996	F		N	P							S	H				
	KOKOMO CREEK - LOWER																		
INB071C_00	Martin - Youngman Ditch basin	6.96		X		X	N							M					
INB071C_T1026	Kokomo Creek - lower	4.29	1996	F		N	N							M	H	T	T		
	LAKE MANITOU - RAIN CREEK/ GRAHAM DITCH																		
INB0652_P1016	Lake Manitou	2.92		X		P	X					S							
	LAURAMIE CREEK																		
INB074C_00	LAURAMIE CREEK	18.1		F		X	N							M					
	LIMBERLOST CREEK - OAKLEY DITCH																		
INB0156_T1024	Limberlost Creek and tributaries above tributary 2	15.1		P		X	X	S											
	LITTLE DEER CREEK - RIDENOUR DITCH																		
INB0556_T1016	Deer Creek above Ridenour Ditch	6.38		F		X	X												
	LITTLE MISSISSINEWA RIVER																		
INB0312_T1002	Little Mississinewa River mainstem	8.42	1998	F		N	X								H				
	LITTLE RIVER - FLAT CREEK																		
INB01B8_00	Little River - Flat Creek	9.6		X		X	X												
	LITTLE RIVER - MUD CREEK																		
INB01BA_00	Little River - Mud Creek	4.16		F		X	N							M					
INB01BA_T1031	Mud Creek	3.84		P		X	N	S						M					
	LITTLE SALAMONIE RIVER - BUCKEYE CREEK																		
INB0214_T1001	Buckeye Creek	3.71		F		X	X												
	LITTLE WILDCAT CREEK - EAST AND WEST FORKS																		
INB0722_00	Little Wildcat Creek - east fork	7.21		F		X	N							S					
INB0722_T1009	Kelly West Ditch	1.83	1996	F		X	F												
INB0722_T1035	Unnamed tributary	0.3		N		X	P						S	S				S	

Uses: F-Full support, P-Partial support, N-Non support, X-Not assessed, A-Not Attainable

* Biological community response; stressor not identified.

Cause/ Stressor magnitude: S-slight, M-moderate, H-High, T-Not impaired; more information needed.

Eastern Corn Belt Plain

Site Specific Index of Biotic Integrity Scores

Sample number:	94,065.00
Site:	LITTLE DEER CREEK
County:	CARROLL
Location:	C.R. 300N Bridge
Drainage:	54.00 (sq mi)

IBI Score	INDEX METRICS	Actual Observation
5	1. Numer of species:	20.00
5	2. Number of d/m/s sp:	3.00
	Number of darter sp:	3.00
3	3. Percent headwater sp:	1.43
	Number of sunfish sp:	3.00
3	4. Number of minnow sp:	8.00
5	Number of sucker sp:	3.00
5	5. Number of sensitive sp:	9.00
	6. Percent tolerants:	5.71
5	7. Percent omnivore:	0.71
5	8. Percent insectivore:	76.43
3	9. Percent pioneer:	27.14
	Percent carnivore:	2.86
1	10. Percent lithophil:	19.29
3	11. CPUE (number individuals):	140.00
5	12. Percent delt:	0.00
48		

"Good"

BIOASSESSMENT SUMMARY
KOKOMO CREEK - HOWARD COUNTY

Purpose

To measure the water quality of Kokomo Creek in Howard County, Indiana by looking at the kinds of animals which live there. Diagnose problems and recommend solutions.

SWCD Monitoring Crew

Watershed Characteristics

The watershed is agricultural and residential. Aquatic habitat suffers from excessive sediment inputs and lack of cover and spawning substrate. Wastewater is discharged to the stream from several facilities.

Results

Kokomo Creek has a biological community which is impaired by sediment, inadequately treated wastewater and habitat degradation.

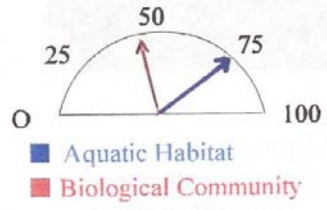
Recommendations

Encourage bank stabilization with vegetative techniques. Plant shading trees along streambanks. Encourage better wastewater treatment.

Date: October 1999 and May 2000

Study conducted by:
Commonwealth Biomonitoring, Inc.
www.biomonitor.com

Watershed Gauge
A score of 100 is our goal



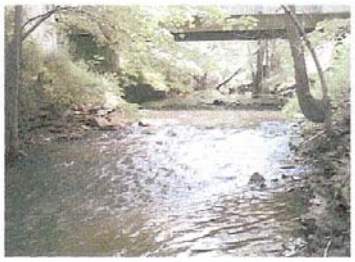
Kokomo Creek Photos

Site 1
Needs trees and buffer

Site 2
Good habitat

Site 3
Needs trees and buffer

Wastewater discharge
Near Site 4



Site 7
Good habitat

Tributaries (1 clear, 1 silty)
Downstream from Site 9
at CR 300 S (severe siltation)

Little Deer Creek
Site 1 - Reference Site

Artesian Spring @ CR 130 E
Upstream from Site 9
Provides clear, cool flow

Tributary on County Line
Not monitored
Recent construction
Severely modified habitat